

## **Management**

How is "management" defined and what are the three broad areas of management control?

What does "good management" begin with?

What does the management function entail?

Describe the common type of management plan used in a treatment plant.

In management, how can "directing" be defined?

Discuss the need and method of public communication for a wastewater plant manager.

How is an emergency operating plan developed?

Discuss the financial management of a wastewater treatment plant.

What should be included in a good maintenance management system of a wastewater treatment plant?

## **Integrated Environmental Management Systems (Reference 16)**

Define an Environmental Management System (EMS)

Discuss the stages of an EMS

Know the Design for the Environment (DfE) Substitutes Tree

Know the Pollution Prevention hierarchy

Define an environmental aspect

Discuss principles that should be part of an environmental policy

## **Safety & Emergency Response**

Discuss safety in a confined space.

Discuss the safety hazards due to oxygen deficiency.

Describe the safety measures in the operation of anaerobic digesters.

What are amines?

Discuss the effect of surface-active agents at a wastewater treatment plant.

Discuss "tailgate" safety meetings.

Discuss the paper work which is important in developing your safety program.

Discuss safety equipment and supplies needed.

Discuss Material Safety Data Sheets (MSDSs).

Describe the atmospheric hazards of confined spaces.

Define "confined space".

What toxic gases may be encountered in the wastewater field.

Can hydrogen sulfide gas be always detected by smell? If not, what is the reason?

Describe flammable/explosive gas.

Discuss the hazard of an oxygen deficient atmosphere.

What precautions are needed in entering a confined space?

What hazardous materials may be encountered during inspection and sampling?

What corrosive materials may be encountered at wastewater treatment plants?

Discuss the infection agents which can be found at a wastewater treatment plant.

Describe the types of physical hazards encountered during sampling and inspection.

Describe safety regulations and OSHA.

Discuss the type of flammable material discharged to the sewer from industries.

Discuss emergency planning.

Discuss the identification of spilled matter.

Discuss the control of spilled matter in sewer.

Describe the POTW process changes during an emergency spill..

Discuss the initial response procedures during an emergency spill.

What steps must be taken in reporting a spill?

## **Maintenance**

What is "water hammer"?

Describe centrifugal pumps.

Describe progressive cavity pumps.

Explain the methods to clean scum lines.

Discuss maintenance of plant tanks and channels.

Describe trouble shooting of malfunctioning meters.

## **Preliminary Treatment**

Discuss the safety hazards around bar screens and racks.

What is the function of grit channels?

Discuss the basics of flow measurement.

Describe the use of a float in the flow measurement of an open channel.

How does a bubbler system work in flow measurement?

Discuss electromagnetic flow meters.

Discuss turbine and propeller type flow meters.

Describe ultrasonic flow meters in a closed pipe.

Describe open-channel flow measurement.

Describe flow measurement by weirs.

Explain the use of dipping probes in the flow measurement.

Describe a capacitance probe in flow measurement.

State methods of checking the accuracies of open channel flow meters.

Explain the use of pitot tubes.

What are velocity modified flow meters?

## **Pretreatment**

Describe U.S. EPA's general pretreatment regulations relative to delegation of federal authority.

What is regulated under the general pretreatment regulations?

What are the categorical pretreatment standards?

What is TTO and how should it be sampled?

What is the general pretreatment regulation?

What is an Enforcement Response Guide (ERG)?

## **Sedimentation**

Discuss troubleshooting of sedimentation tanks.

Describe the principle and function of a primary clarifier.

Discuss the secondary clarifiers for the activated sludge process.

Describe the flotation processes.

Discuss typical clarifier efficiencies.

Compare the loading rates of trickling filter clarifiers with primary clarifiers.

## **Activated Sludge**

Discuss the flow path for oxidation ditches.

Describe the types of package plant treatment processes.

Describe microorganisms of importance in the activated sludge processes.

What are the desirable microorganisms in the activated sludge processes?

Describe the term “endogenous respiration” in the aerobic biological processes.

Discuss the wasting of activated sludge.

Describe the variations of the activated sludge process.

Explain the term “mean cell residence time” (MCRT).

Study the glossary on activated sludge.

Describe the activated sludge process.

Study the design criteria for an oxidation ditch.

Describe the impact of various wastewater discharges to the POTW.

Explain the process changes necessary to meet an upset condition of activated sludge plants.

Discuss the problem of foaming in activated sludge plants.

Explain the rising sludge problems in an activated sludge plant

Describe troubleshooting methods for the activated sludge processes.

Describe the various modes of operation of the activated sludge processes.

Discuss the interpretation of microscopic study of the mixed liquor suspended solids.

Discuss comparing the microscopic results with laboratory process data in an activated sludge plant.

Discuss process changes in an activated sludge plant.

Describe the control methods of return activated sludge.

Discuss the operation strategy for high organic waste loads in an activated sludge plant.

Discuss ammonia removal by breakpoint chlorination.

Discuss nitrogen as a nutrient in a stream.

Describe the different types of nitrogen removal systems.

Describe nitrification.

Discuss denitrification.

How does breakpoint chlorination work in ammonia reduction?

Discuss the ion exchange method of nitrogen removal.

Describe the overland flow system of nitrogen removal.

Discuss the equipment necessary for nitrification.

Describe nitrification using suspended growth reactors.

Compare five types of suspended growth nitrification processes.

Discuss daily operation of the suspended growth denitrification system.

Describe the chemical reaction of the denitrification process.

Discuss the flow sheet of a nitrification-denitrification activated sludge system.

Describe the operation of ammonia stripping from wastewater.

Describe the necessary controls for the breakpoint chlorination method of ammonia reduction.

Study the troubleshooting guide for nitrification systems.

## **Fixed Film**

Describe the troubleshooting methods for the operation of a trickling filter plant.

Describe the operational troubleshooting methods of rotating biological contactors (RBCs).

Describe how to identify problems in a rotating biological contactor (RBC) by observation of the media.

Explain the principles of operation of a trickling filter plant.

How are trickling filters classified?

Discuss the responses to poor trickling filter performance.

Describe the daily operational procedures of a trickling filter.

Discuss ponding in a trickling filter.

Discuss odor problems from a trickling filter operation.

Describe filter fly problems in a trickling filter.

Describe the operational process of a rotating biological contactor.

Discuss the loading calculation on a rotating biological contactor.

## **Disinfection**

Describe the term “chlorine requirement” in wastewater disinfection.

Discuss the effectiveness in microorganism removal by various treatment processes.

Discuss the use of hypochlorite components for disinfection.

Describe the chlorine solution discharge lines.

Discuss the term "compound loop control" in wastewater disinfection by chlorine.

Describe the installation and the maintenance routines of chlorination facilities.

Describe seven basic methods of chlorinator control.

Discuss an operators response to exposure to sulfur dioxide.

Describe the sulfonator parts.

Review the troubleshooting guide for a gas sulfonator system.

Discuss the need of dechlorination.

Describe the term "disinfection".

Describe the reaction of chlorine in wastewater.

Discuss the use of chlorine dioxide in wastewater disinfection.

Discuss the reaction of chlorine with inorganic reducing materials.

Describe the reaction of chlorine with ammonia.

Explain the factors influencing disinfection by chlorine.

Describe a preventive maintenance program for chlorination hazards.

Discuss the safe handling of chlorine cylinders.

Discuss the operation of a chlorinator.



Discuss chlorine injector water supply.

Describe the use of chlorine for odor control.

Describe the chemical reaction of sulfur dioxide with wastewater.

Discuss the method of detection of residual sulfur dioxide.

Describe the term 'ultraviolet irradiation' for disinfection.

What variables affect the efficiency of ultraviolet (U.V.) disinfection?

Describe the elements of a process control system available in ultraviolet disinfection.

Discuss preventive maintenance of an ultraviolet disinfection system.

Describe the equipment used in ultraviolet disinfection.

Discuss the use of ozone for disinfection.

## **Laboratory, Sampling & Monitoring**

Discuss the use of a spectrophotometer.

Describe laboratory safety.

Discuss personal hygiene in the laboratory.

Describe accident prevention in a laboratory.

Discuss representative sampling.

Compare the types of samples.

Discuss the preservation of samples (i.e. BOD, ammonia, solids, pH, and metal testings).

Describe the testing method for settleable solids.

Discuss the determination of total sludge solids.

Compare the settleability test and the settleable solids test.

Describe the determination of sludge age.

Explain the determination of dissolved oxygen in an aerator.

Discuss the determination of mean cell residence time (MCRT).

Discuss the determination of volatile acids for anaerobic digesters.

Discuss the determination of total alkalinity for an anaerobic digester.

Describe the determination of supernatant solids for an anaerobic digester.

Describe the COD determination methods.

Discuss the determination of coliform group bacteria.

Discuss the D.O. measurement by the Winkler method and the D.O. probe.

Describe the methods of BOD measurement and know what samples should be seeded.

Discuss the measurement of pH.

Describe the determination of metals in wastewater.

Explain nitrogen in wastewater and its determination.

Discuss the determination of ammonia nitrogen using an ion-selective electrode.

Discuss the method of oil and grease determination.

Discuss the determination of phosphorus in wastewater.

Discuss the determination of surfactants.

Describe the determination total organic carbon (TOC).

Know the glossary of laboratory terms.

Define a molar solution

Understand the term “oxidation-reduction” reaction.

Discuss the importance of effluent disposal.

Explain the treatment requirements of wastewater.

Describe the monitoring D.O. in receiving waters.

Describe types of receiving waters other than streams and rivers.

Discuss the need for analyzing and presenting data.

Describe the average or arithmetic mean of data.

Describe the range of values of collected data.

Discuss the geometric mean.

Describe the terms 'variance', 'standard deviation', and 'mode'.

Explain how one decides how many samples need to be collected.

Discuss who will analyze the samples after collection.

Discuss what kind of sample containers will be used.

Discuss the collection of a representative sample of an industrial wastewater source to public sewers.

Describe three types of samples.

## **Solids Treatment & Handling**

Discuss the purpose of anaerobic sludge digestion.

Explain how anaerobic digestion works.

Describe the components of an anaerobic digester system.

Explain the function of a floating cover on an anaerobic digester.

Describe the function of flame arresters in an anaerobic digester system.

Describe sediment traps in an anaerobic digester system.

Discuss a waste gas burner in an anaerobic digestion system.

Discuss mixing of an anaerobic digester.

Describe the component parts of a floating cover for an anaerobic digester.

Discuss the effect of raw sludge, waste activated sludge and scum on anaerobic digestion.

Describe the start-up of an anaerobic digester.

Explain foaming in an anaerobic digester.

Describe gas production in an anaerobic sludge digestion system.

Discuss digester supernatant and secondary digesters in an anaerobic digestion system.

Discuss anaerobic digestion control.

Describe the operational strategy of an anaerobic digestion system.

Discuss the need for cleaning an anaerobic digester.

Compare aerobic and anaerobic digestion.

Describe the operation of aerobic digesters.

Describe the operation of sludge drying beds.

Discuss blacktop drying beds.

Describe sludge types and characteristics.

Discuss sludge handling alternatives.

Discuss the factors affecting gravity thickeners.

Describe troubleshooting the operation of gravity thickeners.

Discuss dissolved air flotation thickeners.

Discuss factors affecting dissolved air flotation.

Describe a centrifuge thickener.

What factors will affect the performance of centrifuge thickeners.

Describe the aerobic digestion process.

Discuss troubleshooting of the aerobic digestion process

Discuss the chemical stabilization of sludge.

Describe chemical sludge conditioning.

Discuss factors affecting the thermal conditioning of sludge.

Discuss factors affecting wet oxidation.

Describe a belt filter press.

Describe the operation of vacuum filters for sludge dewatering.

Discuss the dewatering of wet oxidation sludge by sand drying beds.

Describe factors affecting sand drying beds.

Describe the composting of sludge.

Describe factors affecting sludge composting.

Discuss the troubleshooting of sludge composting operations.

Describe the process of sludge incineration.

Discuss disposal of screenings, grit, and scum.

Discuss vectors found in wastewater threatening the public health.

## **Physical-Chemical Treatment**

Discuss the need to remove solids from secondary effluent.

Describe polymeric flocculants.

Describe the use of microscreens.

Describe the use of ultraviolet lights for a microscreen.

Discuss the operational strategy of the microscreening process.

Describe a rapid sand filter system.

Explain the backwashing process of a rapid sand filter.

Discuss surface straining and depth filtration in a rapid sand filtration process.

Discuss the selection of filter media in a rapid sand filter system.

Describe the term 'scouring' in regards to filter media in a rapid sand filter system.

Discuss headloss in a rapid sand filter system.

Describe the normal operation of a rapid sand filter.

Discuss the operational strategy of a rapid sand filter.

Discuss the troubleshooting of a rapid sand filter system.

Discuss phosphorus as a nutrient.

Discuss the types of phosphorus removal systems.

Describe the process of luxury uptake.

Describe a phosphorus stripping tank.

Discuss safety in the luxury uptake phosphorus removal system.

## **Mathematics**

Given the horsepower of a pump and the pumping head, calculate the flow rate of water being pumped.

Given the size of a wet well in a lift station, the drop in water level, and the duration of the drop, calculate the pumping rate.

Given the flow rate, the TDH of a pump system, the efficiency of a pump and motor, and the unit cost of electricity, calculate the cost of operating a pump.

An estimate of the flow in an open channel was made by use of a Pitot tube. Given the water rise, calculate the flow rate.

Given the flow rate, the dimensions of a clarifier, and the concentration of MLSS, determine the detention time, the surface loading, and the solids loading.

Given the flow rate, the aeration tank volume, the MLSS, and the primary effluent TSS, calculate the sludge age; given other pertinent data.

Given the pertinent influent, calculate F/M ratio.

Given the pertinent information, calculate the necessary waste sludge pumping rate.

Given the pertinent information, calculate the mean cell residence time.

Given the primary effluent COD (or BOD), the flow rate, the aerator volume and the desired F/M ratio, determine the necessary MLVSS.

Given the 30 minute settling data and the flow rate, calculate the necessary return sludge rate.

Given the size of an aeration tank and the MLSS, calculate the pounds of solids under aeration.

Calculate the hydraulic and organic loading rates of a trickling filter given the pertinent data.

Given the flow rate and other pertinent data, calculate the feed rate of  $\text{SO}_2$  for dechlorination.

Given the chlorine feed rate, the flow rate, and the residual chlorine, calculate the chlorine demand.

Calculate the feed rate of chlorinated lime given the desired feed rate of chlorine and the chlorine content of chlorinated lime.

Given the polymer pumping rate to a rapid sand filter influent, the filter loading and the polymer concentration, calculate the polymer dosage.

Calculate the volume of seed sludge given the digester size and the required per cent (%) of seed sludge.

Given the volume of raw sludge pumped, the solids content and the volatile solids per cent (%), calculate the poundage volatile solids under digestion.

Given the primary effluent flow rate and the settleable solid test data, estimate the sludge pumping rate to a digester.

Given the volatile solids per cent (%) before (influent) and after (outflow) sludge digestion, calculate the per cent (%) reduction of volatile solids.

Given the dimensions of a piston cylinder and stroke length, calculate the volume of sludge pumped per stroke.

Given pertinent data, calculate the per cent (%) volatile solids.

Calculate the variance given several measurements of the D.O.

Given the normality of a stock acid solution, how many mL of the acid solution will be required to make 1.0 L of 0.02N acid.

Determine the median value given a set of data.

Calculate the geometric mean given a set of data.

Given the BOD test data with seed correction, calculate BOD.

Given pertinent data, calculate the solids loading to a gravity thickener.



Calculate the desired pounds of solids under aeration given the daily solids addition and the desired sludge age.

Determine the effect of an increase in the sludge concentration on the digestion time of an aerobic digester.